Albumen............	10 parts
Magnesium sulphate.	4 parts
Alum..............	9 parts
Calcium sulphate, calcined............	45 parts
Borax.............	2 parts
Water.............	30 parts

The albumen and alum are dissolved in the water and with the solution so obtained the other ingredients are made into a paste. This paste is molded at once in the usual way and when set the articles are exposed in an oven to a heat of 140° F.

TEST FOR TRANSFORMER:

Connect a 22½ volt battery in series with a voltmeter and to one of the primary and one of the secondary terminals. If the coils are shorted the reading on the voltmeter will be over 20 volts.

Thermometers

Table Showing the Comparison of the Readings of Thermometers.

CELSIUS, OR CENTIGRADE (C). RÉAUMUR (R). FAHRENHEIT (F).

C.	R.	F.	C.	R.	F.
−30	−24.0	−22.0	23	18.4	73.4
−25	−20.0	−13.0	24	19.2	75.2
−20	−16.0	− 4.0	25	20.0	77.0
−15	−12.0	+ 5.0	26	20.8	78.8
−10	− 8.0	14.0	27	21.6	80.6
− 5	− 4.0	23.0	28	22.4	82.4
− 4	− 3.2	24.8	29	23.2	84.2
− 3	− 2.4	26.6	30	24.0	86.0
− 2	− 1.6	28.4	31	24.8	87.8
− 1	− 0.8	30.2	32	25.6	89.6
			33	26.4	91.4
Freezing point of water.			34	27.2	93.2
			35	28.0	95.0
0	0.0	32.0	36	28.8	96.8
1	0.8	33.8	37	29.6	98.6
2	1.6	35.6	38	30.4	100.4
3	2.4	37.4	39	31.2	102.2
4	3.2	39.2	40	32.0	104.0
5	4.0	41.0	41	32.8	105.8
6	4.8	42.8	42	33.6	107.6
7	5.6	44.6	43	34.4	109.4
8	6.4	46.4	44	35.2	111.2
9	7.2	48.2	45	36.0	113.0
10	8.0	50.0	50	40.0	122.0
11	8.8	51.8	55	44.0	131.0
12	9.6	53.6	60	48.0	140.0
13	10.4	55.4	65	52.0	149.0
14	11.2	57.2	70	56.0	158.0
15	12.0	59.0	75	60.0	167.0
16	12.8	60.8	80	64.0	176.0
17	13.6	62.6	85	68.0	185.0
18	14.4	64.4	90	72.0	194.0
19	15.2	66.2	95	76.0	203.0
20	16.0	68.0	100	80.0	212.0
21	16.8	69.8			
22	17.6	71.6	Boiling point of water.		

Readings on one scale can be changed into another by the following formulas, in which $t°$ indicates degrees of temperature:

Réau. to Fahr.

$$\frac{9}{4}t° \text{ R} + 32° = t° \text{ F}$$

Cent. to Fahr.

$$\frac{9}{5}t° \text{ C} + 32° = t° \text{ F}$$

Réau to Cent.

$$\frac{5}{4}t° \text{ R} = t° \text{ C}$$

Cent. to Réau.

$$\frac{4}{5}t° \text{ C} = t° \text{ R}$$

Fahr. to Cent.

$$\frac{5}{9}\left(t° \text{ F} - 32°\right) = t° \text{ C}$$

Fahr. to Réau.

$$\frac{4}{9}\left(t° \text{ F} - 32°\right) = t° \text{ R}$$

THREAD:

See also Cordage.

Dressing for Sewing Thread.—For colored thread: Irish moss, 3 pounds; gum arabic, 2½ pounds; Japan wax, ½ pound; stearine, 185 grams; borax, 95 grams; boil together for ¼ hour.

For white thread: Irish moss, 2 pounds; tapioca, 1½ pounds; spermaceti, ¾ pound; stearine, 110 grams; borax, 95 grams; boil together for 20 minutes.

For black thread: Irish moss, 3 pounds; gum Senegal, 2½ pounds; ceresin, 1 pound; borax, 95 grams; logwood extract, 95 grams; blue vitriol, 30 grams; boil together for 20 minutes. Soak the Irish moss in each case overnight in 45 liters of water, then boil for 1 hour, strain and add the other ingredients to the resulting solution. It is of advantage to add the borax to the Irish moss before the boiling.

THROAT LOZENGES:

See Confectionery.

THYMOL:

See Antiseptics.

TICKS, CATTLE DIP FOR:

See Insecticides.

TIERCES:

See Disinfectants.

TILEMAKERS' NOTES:

See Ceramics.

Tin

Etching Bath for Tin.—The design is either freely drawn upon the metal with a needle or a lead pencil, or pricked into the metal through tracing paper with a needle. The outlines are filled with a varnish (wax, colophony, asphalt). The varnish is rendered fluid with turpentine and applied with a brush. The article after having dried is laid in a ⅕ solution of nitric acid for 1½ to 2 hours. It is then washed and dried with blotting

paper. The protective coating of asphalt is removed by heating. The zinc oxide in the deeper portions is cleaned away with a silver soap and brush.

Recovery of Tin and Iron in Tinned-Plate Clippings.—The process of utilizing tinned-plate scrap consists essentially in the removal of the tin. This must be very completely carried out if the remaining iron is to be available for casting. The removal of the outer layer of pure tin from the tinned plate is an easy matter. Beneath this, however, is another crystalline layer consisting of an alloy of tin and iron, which is more difficult of treatment. It renders the iron unavailable for casting, as even 0.2 per cent of tin causes brittleness. Its removal is best accomplished by electrolysis. If dilute sulphuric acid is used as an electrolyte, the deposit is spongy at first, and afterwards, when the acid has been partly neutralized, crystalline. After 6 hours the clippings are taken out and the iron completely dissolved in dilute sulphuric acid; the residue of tin is then combined with the tin obtained by the electrolysis. Green vitriol is therefore a by-product in this process.

Gutensohn's process has two objects: To obtain tin and to render the iron fit for use. The tin is obtained by treating the tinned plate repeatedly with hydrochloric acid. The tin is then removed from the solution by means of the electric current. The tinned plate as the positive pole is placed in a tank made of some insulating material impervious to the action of acids, such as slate. A copper plate forms the cathode. The bichloride of tin solution, freed from acid, is put round the carbon cylinder in the Bunsen element. Another innovation in this process is that the tank with the tinned-plate clippings is itself turned into an electric battery with the aid of the tin. A still better source of electricity is, however, obtained during the treatment of the untinned iron which will be described presently. The final elimination of the tin takes place in the clay cup of the Bunsen elements. Besides the chloride of tin solution (free from acid), another tin solution, preferably chromate of tin, nitrate of tin, or sulphate of tin, according to the strength of the current desired, may be used. To render the iron of the tinned plate serviceable the acid is drawn off as long as the iron is covered with a thin layer of an alloy of iron and tin. The latter makes the iron unfit for use in rolling mills or for the precipitation of copper. Fresh hydrochloric acid or sulphuric acid is therefore poured over the plate to remove the alloy, after the treatment with the bichloride of tin solution. This acid is also systematically used in different vats to the point of approximate saturation. This solution forms the most suitable source of electricity, a zinc-iron element being formed by means of a clay cell and a zinc cylinder. The electrical force developed serves to accelerate the solution in the next tank, which contains tinned plate, either fresh or treated with hydrochloric acid. Ferrous oxide, or spongy metallic iron if the current is very strong, is liberated in the iron battery. Both substances are easily oxidized, and form red oxide of iron when heated. The remaining solution can be crystallized by evaporation, so that ferrous sulphate (green vitriol) or ferric chloride can be obtained, or it can be treated to form red oxide of iron.

Tin in Powder Form.—To obtain tin in powder form the metal is first melted; next pour it into a box whose sides, etc., are coated with powdered chalk. Agitate the box vigorously and without discontinuing, until the metal is entirely cold. Now pass this powder through a sieve and keep in a closed flask. This tin powder is eligible for various uses and makes a handsome effect, especially in bronzing. It can be browned.

TINFOIL:

See also Metal Foil.

By pouring tin from a funnel with a very long and narrow mouth upon a linen surface, the latter being tightly stretched, covered with a mixture of chalk and white of egg, and placed in a sloping position, very thin sheets can be produced, and capable of being easily transformed into thin foil. Pure tin should never be used in the preparation of foil intended for packing tobacco, chocolate, etc., but an alloy containing 5 to 40 per cent of lead. Lead has also been recently plated on both sides with tin by the following method: A lead sheet from 0.64 to .80 inches thick is poured on a casting table as long as it is hot, a layer of tin from 0.16 to 0.20 inches in thickness added, the sheet then turned over and coated on the other side with tin in the same manner. The sheet is then stretched between rollers. Very thin sheet tin can also be made in the same way as sheet lead, by cutting up a tin cylinder into spiral sections. Colored tinfoil is prepared by making the foil thoroughly bright by rubbing with purified chalk

and cotton, then adding a coat of gelatin, colored as required, and covering the whole finally with a transparent spirit varnish. In place of this somewhat troublesome process, the following much simpler method has lately been introduced: Aniline dyes dissolved in alcohol are applied on the purified foil, and the coat, when dry, covered with a very thin layer of a colorless varnish. This is done by pouring the varnish on the surface and then inclining the latter so that the varnish may reach every part and flow off.

TIN, SILVER-PLATING:
See Plating.

TIN VARNISHES:
See Varnishes.

TINNING:
See Plating.

TIRE:

Anti-Leak Rubber Tire.—Pneumatic tires can be made quite safe from punctures by using a liberal amount of the following cheap mixture: One pound of sheet glue dissolved in hot water in the usual manner, and 3 pints of molasses. This mixture injected into the tire through the valve stem, semi-hardens into an elastic jelly, being, in fact, about the same as the well-known ink roller composition used for the rollers of printing presses. This treatment will usually be found to effectually stop leaks in punctured or porous tires.

TIRE CEMENTS:
See Adhesives, under Rubber Cements.

TISSIER'S METAL:
See Alloys.

TITANIUM STEEL:
See Steel.

TOILET DEODORANT:

Eucalyptol	½	ounce
Thymol	1	dram
Borax	5	ounces

This should be well mixed, then dissolve in the following solution:

Camphor water	20	ounces
Glycerine	10	ounces
Cresote water	52	ounces

After being well mixed, the fluid should be filtered to remove any foreign matter that did not dissolve. Then bottle and cork tightly. A few drops of this fluid is dropped into the water in the toilet, or used in the water that you are washing the toilet out with.

TONKA, ITS DETECTION IN VANILLA EXTRACTS:
See Vanilla.

TOOL SETTING.

The term "setting" (grinding) is applied to the operation of giving an edge to the tools designed for cutting, scraping, or sawing. Cutting tools are rubbed either on flat sandstones or on rapidly turned grindstones. The wear on the faces of the tools diminishes their thickness and renders the cutting angle sharper. Good edges cannot be obtained except with the aid of the grindstone; it is therefore important to select this instrument with care. It should be soft, rather than hard, of fine, smooth grain, perfectly free from seams or flaws. The last condition is essential, for it often happens that, under the influence of the revolving motion, a defective stone suddenly yields to the centrifugal force, bursts and scatters its pieces with such violence as to wound the operator. This accident may also happen with perfectly formed stones. On this account artificial stones have been substituted, more homogeneous and coherent than the natural ones.

Whatever may be the stone selected, it ought to be kept constantly moist during the operation. If not, the tools will soon get heated and their temper will be impaired. When a tool has for a certain time undergone the erosive action of the stone, the cutting angle becomes too acute, too thin, and bends over on itself, constituting what is called "the feather edge." This condition renders a new setting necessary, which is usually effected by bending back the feather edge, if it is long, and whetting the blade on a stone called a "setter." There are several varieties of stones used for this purpose, though they are mostly composed of calcareous or argilaceous matter, mixed with a certain proportion of silica.

The scythestone, of very fine grain, serves for grinding off the feather edge of scythes, knives, and other large tools. The Lorraine stone, of chocolate color and fine grain, is employed with oil for carpenters' tools. American carborundum is very erosive. It is used with water and with oil to obtain a fine edge. The lancet stone is not inferior to any of the preceding. As its name indicates, it is used for sharpening surgical instruments, and only with oil. The Levant stone (Turkish sandstone) is the best of all for whetting. It is gray and semi-transparent; when of inferior quality, it

is somewhat spotted with red. It is usually quite soft.

To restore stones and efface the inequalities and hollows caused by the friction of the tools, they are laid flat on a marble or level stone, spread over with fine, well-pulverized sandstone, and rubbed briskly. When tools have a curved edge, they are subjected to a composition formed of pulverized stone, molded into a form convenient for the concavity or convexity. Tools are also whetted with slabs of walnut or aspen wood coated with emery of different numbers, which produces an excellent setting.

TOOL LUBRICANT:
See Lubricant.

Toothache

TOOTHACHE GUMS:
See also Pain Killers.

I.—Paraffine	94	grains
Burgundy pitch	800	grains
Oil of cloves	½	fluidrachm
Creosote	½	fluidrachm

Melt the first two ingredients, and, when nearly cool, add the rest, stirring well. May be made into small pills or turned out in form of small cones or cylinders.

II.—Melt white wax or spermaceti, 2 parts, and when melted add carbolic-acid crystals, 1 part, and chloral-hydrate crystals, 2 parts; stir well until dissolved. While still liquid, immerse thin layers of carbolized absorbent cotton wool and allow them to dry. When required for use a small piece may be snipped off and slightly warmed, when it can be inserted into the hollow tooth, where it will solidify.

Toothache Remedy.—

Camphor	4 drachms
Chloral hydrate	4 drachms
Oil of cloves	2 drachms
Oil of cajeput	2 drachms
Chloroform	12 drachms
Tincture of capsicum	24 drachms

TOOTH CEMENTS:
See Cements.

TOOTH PASTES, POWDERS, SOAPS, AND WASHES:
See Dentifrices.

TORTOISE-SHELL POLISHES:
See Polishes.

TOOTH STRAIGHTENING:
See Watchmakers' Formulas.

TOUCHSTONE, AQUAFORTIS FOR THE:
See Aquafortis.

TOY PAINT:
See Paint.

TRACING-CLOTH CLEANERS:
See Cleaning Preparations and Methods.

TRAGACANTH, MUCILAGE OF:
See Adhesives, under Mucilages.

TRANSPARENCIES:
See also Photography.

A good method of preparing handsome London transparencies is as follows:

White paper is coated with a liquid whose chief constituent is Iceland moss strongly boiled down in water to which a slight quantity of previously dissolved gelatin is added. In applying the mass, which should always be kept in a hot condition, the paper should be covered uniformly throughout. After it has been dried well it is smoothed on the coated side and used for a proof. The transparent colors to be used must be ground in stronger varnish than the opaque ones. In order to produce a handsome red, yellow lake and red sienna are used; the tone of the latter is considerably warmer than that of the yellow lake. Where the cost is no consideration, aurosolin may also be employed. For pale red, madder lakes should be employed, but for darker shades, crimson lakes and scarlet cochineal lakes. The vivid geranium lake gives a magnificent shade, which, however, is not at all fast in sunlight. The most translucent blue will always be Berlin blue. For purple, madder purple is the most reliable color, but possesses little gloss. Luminous effects can be obtained with the assistance of aniline colors, but these are only of little permanence in transparencies. Light, transparent green is hardly available. Recourse has to be taken to mixing Berlin blue with yellow lake, or red sienna. Green chromic oxide may be used if its sober, cool tone has no disturbing influence. Almost all brown coloring bodies give transparent colors, but the most useful are madder lakes and burnt umber. Gray is produced by mixing purple tone colors with suitable brown, but a gray color hardly ever oc-

curs in transparent prints. Liquid siccative must always be added to the colors, otherwise the drying will occupy too much time. After the drying, the prints are varnished on both sides. For this purpose, a well-covering, quickly drying, colorless, not too thick varnish must be used, which is elastic enough not to crack nor to break in bending.

Frequently the varnishing of the placards is done with gelatin. This imparts to the picture an especially handsome, luminous luster. After an equal quantity of alcohol has been added to a readily flowing solution of gelatin, kept for use in a zinc vessel, the gelatin solution is poured on the glass plates destined for the transparencies. After a quarter of an hour, take the placard, moisten its back uniformly, and lay it upon a gelatin film which has meanwhile formed on the glass plate, where it remains 2 to 3 days. When it is to be removed from the plate, the edge of the gelatin film protruding over the edge of the placard is lifted up with a dull knife, and it is thus drawn off. A fine, transparent gloss remains on the placard proper. In order to render the covering waterproof and pliable, it is given a coating of collodion, which does not detract from the transparence. The glass plates and their frames must be cleaned of adhering gelatin particles before renewed use.

TRANSFER PROCESSES:

To Transfer Designs.—Designs can be transferred on painted surfaces, cloth, leather, velvet, oil cloth, and linen sharply and in all the details with little trouble. Take the original design, lay it on a layer of paper, and trace the lines of design accurately with a packing needle, the eye of which is held by a piece of wood for a handle. It is necessary to press down well. The design becomes visible on the back by an elevation. When everything has been accurately pressed through, take, e. g., for dark objects, whiting (formed in pieces), lay the design face downward on the knee and pass mildly with the whiting over the elevations; on every elevation a chalk line will appear. Then dust off the superfluous whiting with the fingers, lay the whiting side on the cloth to hold it so that it cannot slide, and pass over it with a soft brush. For light articles take powdered lead pencil, which is rubbed on with the finger, or limewood charcoal. For tracing use oil paint on cloth and India ink on linen.

To Copy Engravings.—To make a facsimile of an engraving expose it in a warm, closed box to the vapor of iodine, then place it, inkside downward, on a smooth, dry sheet of clean white paper, which has been brushed with starch water. After the two prepared surfaces have been in contact for a short time a facsimile of the engraving will be reproduced more or less accurately, according to the skill of the operator.

To Transfer Engravings.—The best way to transfer engraving from one piece to another is to rub transfer wax into the engraved letters. This wax is made of beeswax, 3 parts; tallow, 3 parts; Canada balsam, 1 part; olive oil, 1 part. If the wax becomes too hard, add a few drops of olive oil, and if too soft, a little more beeswax. Care should be taken that the wax does not remain on the surface about the engraving, otherwise the impression would be blurred. Then moisten a piece of paper by drawing it over the tongue and lay it on the engraving. Upon this is laid another piece of dry paper, and securing both with the thumb and forefinger of the left hand, so they will not be moved, go over the entire surface with a burnisher made of steel or bone, with a pointed end. This will press the lower paper into the engraving and cause the wax to adhere to it. Then the top paper is removed and the corner of the lower one gently raised. The whole is then carefully peeled off, and underneath will be found a reversed, sharp impression of the engraving. The edges of the paper are then cut so it can be fitted in a position on the other articles similar to that on the original one. When this is done lay the paper in the proper position and rub the index finger lightly over it, which will transfer a clear likeness of the original engraving. If due care is taken two dozen or more transfers can be made from a single impression.

TRAPPING RABBITS:

A mixture consisting of equal parts of—

Oil of anise
Oil of caraway
Oil of rhodium

smeared on traps will prove effective in attracting rabbits.

TUNGSTEN STEEL:

See Steel.

TURMERIC IN FOOD:

See Foods.

TURPENTINE STAINS:

See Wood.

TURTLE (MOCK) EXTRACT:
See Condiments.

TWINE:
See also Thread and Cordage.

Tough twine may be greatly strengthened by dissolving plenty of alum in water and laying the twine in this solution. After drying, the twine will have much increased tensile strength.

Typewriter Ribbons

(See also Inks.)

The constituents of an ink for typewriter ribbons may be broadly divided into four elements: 1, the pigment; 2, the vehicle; 3, the corrigent; 4, the solvent. The elements will differ with the kind of ink desired, whether permanent or copying.

Permanent (Record) Ink.—Any finely divided, non-fading color may be used as the pigment; vaseline is the best vehicle and wax the best corrigent. In order to make the ribbon last a long time with one inking, as much pigment as feasible should be used. To make black record ink: Take some vaseline, melt it on a slow fire or water bath, and incorporate by constant stirring as much lampblack as it will take up without becoming granular. Take from the fire and allow it to cool. The ink is now practically finished, except, if not entirely suitable on trial, it may be improved by adding the corrigent wax in small quantity. The ribbon should be charged with a very thin, evenly divided amount of ink. Hence the necessity of a solvent—in this instance a mixture of equal parts of petroleum benzine and rectified spirit of turpentine. In this mixture dissolve a sufficient amount of the solid ink by vigorous agitation to make a thin paint. Try the ink on one extremity of the ribbon; if too soft, add a little wax to make it harder; if too pale, add more coloring matter; if too hard, add more vaseline. If carefully applied to the ribbon, and the excess brushed off, the result will be satisfactory.

On the same principle, other colors may be made into ink; but for delicate colors, albolene and bleached wax should be the vehicle and corrigent, respectively.

The various printing inks may be used if properly corrected. They require the addition of vaseline to make them non-drying on the ribbon, and of some wax if found too soft. Where printing inks are available, they will be found to give excellent results if thus modified, as the pigment is well milled and finely divided. Even black cosmetic may be made to answer, by the addition of some lamp-black to the solution in the mixture of benzine and turpentine.

After thus having explained the principles underlying the manufacture of permanent inks, we can pass more rapidly over the subject of copying inks, which is governed by the same general rules.

For copying inks, aniline colors form the pigment; a mixture of about 3 parts of water and 1 part of glycerine, the vehicle; transparent soap (about $\frac{1}{4}$ part), the corrigent; stronger alcohol (about 6 parts), the solvent. The desired aniline color will easily dissolve in the hot vehicle, soap will give the ink the necessary body and counteract the hygroscopic tendency of the glycerine, and in the stronger alcohol the ink will readily dissolve, so that it can be applied in a finely divided state to the ribbon, where the evaporation of the alcohol will leave it in a thin film. There is little more to add. After the ink is made and tried—if too soft, add a little more soap; if too hard, a little more glycerine; if too pale, a little more pigment. Printer's copying ink can be utilized here likewise.

Users of the typewriter should so set a fresh ribbon as to start at the edge nearest the operator, allowing it to run back and forth with the same adjustment until exhausted along that strip; then shift the ribbon forward the width of one letter, running until exhausted, and so on. Finally, when the whole ribbon is exhausted, the color will have been equably used up, and on reinking, the work will appear even in color, while it will look patchy if some of the old ink has been left here and there and fresh ink applied over it.

UDDER INFLAMMATION:
See Veterinary Formulas.

VALVES.

The manufacturers of valves test each valve under hydraulic pressure before it is sent out from the factory, yet they frequently leak when erected in the pipe lines. This is due to the misuse of the erector in most cases. The following are the most noteworthy bad practices to be avoided when fitting in valves:

I.—Screwing a valve on a pipe very tightly, without first closing the valve. Closing the valve makes the body much

more rigid and able to withstand greater strains and also keeps the iron chips from lodging under the seats, or in the working parts of the valves. This, of course, does not apply to check valves.

II.—Screwing a long mill thread into a valve. The threads on commercial pipes are very long and should never be screwed into a valve. An elbow or tee will stand the length of thread very well, but a suitable length thread should be cut in every case on the pipe, when used to screw into a valve. If not, the end of pipe will shoulder against the seat of valve and so distort it that the valve will leak very badly.

III.—The application of a pipe wrench on the opposite end of the valve from the end which is being screwed on the pipe. This should never be done, as it invariably springs or forces the valve seats from their true original bearing with the disks.

IV.—Never place the body of a valve in the vise to remove the bonnet or centerpiece from a valve, as it will squeeze together the soft brass body and throw all parts out of alignment. Properly to remove the bonnet or centerpiece from a valve, either screw into each end of the valve a short piece of pipe and place one piece of the pipe in the vise, using a wrench on the square of bonnet; or if the vise is properly constructed, place the square of the bonnet in same and use the short piece of pipe screwed in each end as a lever. When using a wrench on square of bonnet or centerpiece, use a Stillson or Trimo wrench with a piece of tin between the teeth of the jaws and the finished brass. It may mark the brass slightly, but this is preferable to rounding off all the corners with an old monkey wrench which is worn out and sprung. As the threads on all bonnets or centerpieces are doped with litharge or cement, a sharp jerk or jar on the wrench will start the bonnet much more quickly than a steady pull. Under no circumstances try to replace or remove the bonnet or centerpiece of a valve without first opening it wide. This will prevent the bending of the stem, forcing the disk down through the seat or stripping the threads on bonnet where it screws into body. If it is impossible to remove bonnet or centerpiece by ordinary methods, heat the body of the valve just outside the thread. Then tap lightly all around the thread with a soft hammer. This method never fails, as the heat expands the body ring and breaks the joint made by the litharge or cement.

V.—The application of a large monkey wrench to the stuffing box of valve. Many valves are returned with the stuffing boxes split, or the threads in same stripped. This is due to the fact that the fitter or engineer has used a large-sized monkey wrench on this small part.

VI.—The screwing into a valve of a long length of unsupported pipe. For example, if the fitter is doing some repair work and starts out with a run of 2-inch horizontal pipe from a 2-inch valve connected to main steam header, the pipe being about 18 feet long, after he has screwed the pipe tightly into the valve, he leaves the helper to support the pipe at the other end, while he gets the hanger ready. The helper in the meantime has become tired and drops his shoulder on which the pipe rests about 3 inches and in consequence the full weight of this 18-foot length of pipe bears on the valve. The valve is badly sprung and when the engineer raises steam the next morning the valve leaks. When a valve is placed in the center of a long run of pipe, the pipe on each side, and close to the valve, should be well supported.

VII.—The use of pipe cement in valves. When it is necessary to use pipe cement in joints, this mixture should always be placed on the pipe thread which screws into the valve, and never in the valve itself. If the cement is placed in the valve, as the pipe is screwed into the valve it forces the cement between the seats and disks, where it will soon harden and thus prevent the valve from seating properly.

VIII.—Thread chips and scale in pipe. Before a pipe is screwed into a valve it should be stood in a vertical position and struck sharply with a hammer. This will release the chips from the thread cutting, and loosen the scale inside of pipe. When a pipe line containing valves is connected up, the valves should all be opened wide and the pipe well blown out before they are again closed. This will remove foreign substances which are liable to cut and scratch the seats and disks.

IX. — Expansion and contraction. Ample allowance must be provided for expansion and contraction in all steam lines, especially when brass valves are included. The pipe and fittings are much more rigid and stiff than the brass valves and in consequence the expansion strains will relieve themselves at the weakest point, unless otherwise provided for.

X.—The use of wrenches or bars on valve wheels to close the valves tightly. This should never be done, as it springs the entire valve and throws all parts out of alignment, thus making the valve leak. The manufacturer furnishes a wheel sufficiently large properly to close against any pressure for which it is suitable. If the valves cannot be closed tightly by this means, there is something between the disks and seats or they have been cut or scratched by foreign substances.

Vanilla

(See also Essences and Extracts.)

The best Mexican vanilla yields only in the neighborhood of 1.7 per cent of vanillin; that from Reunion and Guadeloupe about 2.5 per cent; and that from Java 2.75 per cent. There seems to be but little connection between the quantity of vanillin contained in vanilla pods and their quality as a flavor producer. Mexican beans are esteemed the best and yet they contain far less than the Java. Those from Brazil and Peru contain much less than those from Mexico, and yet they are considered inferior in quality to most others. The vanillin of the market is chiefly, if not entirely, artificial and is made from the coniferin of such pines and firs as abies excelsa, a. pectinata, pinus cembra, and p. strobus, as well as from the eugenol of cloves and allspice. Vanillin also exists in asparagus, lupine seeds, the seeds of the common wild rose, asafetida, and gum benzoin.

A good formula for a vanilla extract is the following:

Vanilla..........	1 ounce
Tonka...........	2 ounces
Alcohol, deodorized...........	32 fluidounces
Syrup...........	8 fluidounces

Cut and bruise the vanilla, afterwards adding and bruising the Tonka; macerate for 14 days in 16 fluidounces of the alcohol, with occasional agitation; pour off the clear liquid and set aside; pour the remaining alcohol on the magma, and heat by means of a water bath to about 168° F., in a closely covered vessel. Keep it at that temperature for 2 or 3 hours, then strain through flannel with slight pressure; mix the two portions of liquid and filter through felt. Lastly, add the syrup. To render this tincture perfectly clear it may be treated with pulverized magnesium carbonate, using from ½ to 1 drachm to each pint.

To Detect Artificial Vanillin in Vanilla Extracts (see also Foods).—There is no well-defined test for vanillin, but one can get at it in a negative way. The artificial vanillin contains vanillin identical with the vanillin contained in the vanilla bean; but the vanilla bean, as the vanilla extract, contains among its many "extractive matters" which enter into the food and fragrant value of vanilla extract, certain rosins which can be identified with certainty in analysis by a number of determining reactions. Extract made without true vanilla can be detected by negative results in all these reactions.

Vanilla beans contain 4 to 11 per cent of this rosin. It is of a dark red to brown color and furnishes about one-half the color of the extract of vanilla. This rosin is soluble in 50 per cent alcohol, so that in extracts of high grade, where sufficient alcohol is used, all rosin is kept in solution. In cheap extracts, where as little as 20 per cent of alcohol by volume is sometimes used, an alkali—usually potassium bicarbonate—is added to aid in getting rosin, gums, etc., in solution, and to prevent subsequent turpidity. This treatment deepens the color very materially.

Place some of the extract to be examined in a glass evaporating dish and evaporate the alcohol on the water bath. When alcohol is removed, make up about the original volume with hot water. If alkali has not been used in the manufacture of the extract, the rosin will appear as a flocculent red to brown residue. Acidify with acetic acid to free rosin from bases, separating the whole of the rosin and leaving a partly decolorized, clear supernatant liquid after standing a short time. Collect the rosin on a filter, wash with water, and reserve the filtrate for further tests.

Place a portion of the filter with the attached rosin in a few cubic centimeters of dilute caustic potash. The rosin is dissolved to a deep-red solution. Acidify. The rosin is thereby precipitated. Dissolve a portion of the rosin in alcohol; to one fraction add a few drops of ferric chloride; no striking coloration is produced. To another portion add hydrochloric acid; again there is little change in color. In alcoholic solution most rosins give color reactions with ferric chloride or hydrochloric acid. To a portion of the filtrate obtained above add a few drops of basic lead acetate. The precipitate is so bulky as to almost

solidify, due to the excessive amount of organic acids, gums, and other extractive matter. The filtrate from this precipitate is nearly, but not quite, colorless. Test another portion of the filtrate from the rosin for tannin with a solution of gelatin. Tannin is present in varying but small quantities. It should not be present in great excess.

To Detect Tonka in Vanilla Extract.—The following test depends on the chemical difference between coumarin and vanillin, the odorous principles of the two beans. Coumarin is the anhydride of coumaric acid, and on fusion with a caustic alkali yields acetic and salicylic acids, while vanillin is methyl protocatechin aldehyde, and when treated similarly yields protocatechuic acid. The test is performed by evaporating a small quantity of the extract to dryness, and melting the residue with caustic potash. Transfer the fused mass to a test tube, neutralize with hydrochloric acid, and add a few drops of ferric chloride solution. If Tonka be present in the extract, the beautiful violet coloration characteristic of salicylic acid will at once become evident.

Vanilla Substitute.—A substitute for vanilla extract is made from synthetic vanillin. The vanillin is simply dissolved in diluted alcohol and the solution colored with a little caramel and sweetened perhaps with syrup. The following is a typical formula:

Vanillin	1 ounce
Alcohol	6 quarts
Water	5 quarts
Syrup	1 quart
Caramel sufficient to color.	

An extract so made does not wholly represent the flavor of the bean; while vanillin is the chief flavoring constituent of the bean, there are present other substances which contribute to the flavor; and connoisseurs prefer this combination, the remaining members of which have not yet been made artificially.

VANILLIN:
See Vanilla.

Varnishes

(See also Enamels, Glazes, Oils, Paints, Rust Preventives, Stains, and Waterproofing.)

Varnish is a solution of resinous matter forming a clear, limpid fluid capable of hardening without losing its transparency. It is used to give a shining, transparent, hard, and preservative covering to the finished surface of woodwork, capable of resisting in a greater or less degree the influence of the air and moisture. This coating, when applied to metal or mineral surfaces, takes the name of lacquer, and must be prepared from rosins at once more adhesive and tenacious than those entering into varnish.

The rosins, commonly called gums, suitable for varnish are of two kinds—the hard and the soft. The hard varieties are copal, amber, and the lac rosins. The dry soft rosins are juniper gum (commonly called sandarac), mastic, and dammar. The elastic soft rosins are benzoin, elemi, anime, and turpentine. The science of preparing varnish consists in combining these classes of rosins in a suitable solvent, so that each conveys its good qualities and counteracts the bad ones of the others, and in giving the desired color to this solution without affecting the suspension of the rosins, or detracting from the drying and hardening properties of the varnish.

In spirit varnish (that made with alcohol) the hard and the elastic gums must be mixed to insure tenderness and solidity, as the alcohol evaporates at once after applying, leaving the varnish wholly dependent on the gums for the tenacious and adhesive properties; and if the soft rosins predominate, the varnish will remain "tacky" for a long time. Spirit varnish, however good and convenient to work with, must always be inferior to oil varnish, as the latter is at the same time more tender and more solid, for the oil in oxidizing and evaporating thickens and forms rosin which continues its softening and binding presence, whereas in a spirit varnish the alcohol is promptly dissipated, and leaves the gums on the surface of the work in a more or less granular and brittle precipitate which chips readily and peels off.

Varnish must be tender and in a manner soft. It must yield to the movements of the wood in expanding or contracting with the heat or cold, and must not inclose the wood like a sheet of glass. This is why oil varnish is superior to spirit varnish. To obtain this suppleness the gums must be dissolved in some liquid not highly volatile like spirit, but one which mixes with them in substance permanently to counteract their extreme friability. Such solvents are the oils of lavender, spike, rosemary, and turpentine, combined with linseed oil. The vehicle in which the rosins are dissolved must be soft and remain so in order to

keep the rosins soft which are of themselves naturally hard. Any varnish from which the solvent has completely dried out must of necessity become hard and glassy and chip off. But, on the other hand, if the varnish remains too soft and "tacky," it will "cake" in time and destroy the effect desired.

Aside from this, close observers if not chemists will agree that for this work it is much more desirable to dissolve these rosins in a liquid closely related to them in chemical composition, rather than in a liquid of no chemical relation and which no doubt changes certain properties of the rosins, and cuts them into solution more sharply than does turpentine or linseed oil. It is a well-known fact that each time glue is liquefied it loses some of its adhesive properties. On this same principle it is not desirable to dissolve varnish rosins in a liquid very unlike them, nor in one in which they are quickly and highly soluble. Modern effort has been bent on inventing a cheap varnish, easily prepared, that will take the place of oil varnish, and the market is flooded with benzine, carbon bisulphide, and various ether products which are next to worthless where wearing and durable properties are desired.

Alcohol will hold in solution only about one-third of its weight in rosins. Turpentine must be added always last to spirit varnish. Turpentine in its clear recently distilled state will not mix with alcohol, but must first be oxidized by exposing it to the air in an uncorked bottle until a small quantity taken therefrom mixes perfectly with alcohol. This usually takes from a month to six weeks. Mastic must be added last of all to the ingredients of spirit varnish, as it is not wholly soluble in alcohol but entirely so in a solution of rosins in alcohol. Spirit varnishes that prove too hard and brittle may be improved by the addition of either of the oils of turpentine, castor seed, lavender, rosemary, or spike, in the proportion required to bring the varnish to the proper temper.

Coloring "Spirit" Varnishes. — In modern works the following coloring substances are used, separately and in blends: Saffron (brilliant golden yellow), dragon's blood (deep reddish brown), gamboge (bright yellow), Socotrine or Bombay aloes (liver brown), asphalt, ivory, and bone black (black), sandalwood, pterocarpus santalinus, the heartwood (dark red), Indian sandalwood, pterocarpus indica, the heartwood (orange red), brazil wood (dark yellow), myrrh (yellowish to reddish brown; darkens on exposure), madder (reddish brown), logwood (brown), red scammony rosin (light red), turmeric (orange yellow), and many others according to the various shades desired.

Manufacturing Hints.—Glass, coarsely powdered, is often added to varnish when mixed in large quantities for the purpose of cutting the rosins and preventing them from adhering to the bottom and sides of the container. When possible, varnish should always be compounded without the use of heat, as this carbonizes and otherwise changes the constituents, and, besides, danger always ensues from the highly inflammable nature of the material employed. However, when heat is necessary, a water bath should always be used; the varnish should never fill the vessel over a half to three-fourths of its capacity.

The Gums Used in Making Varnish.—Juniper gum or true sandarac comes in long, yellowish, dusty tears, and requires a high temperature for its manipulation in oil. The oil must be so hot as to scorch a feather dipped into it, before this gum is added; otherwise the gum is burned. Because of this, juniper gum is usually displaced in oil varnish by gum dammar. Both of these gums, by their dryness, counteract the elasticity of oil as well as of other gums. The usual sandarac of commerce is a brittle, yellow, transparent rosin from Africa, more soluble in turpentine than in alcohol. Its excess renders varnish hard and brittle. Commercial sandarac is also often a mixture of the African rosin with dammar or hard Indian copal, the place of the African rosin being sometimes taken by true juniper gum. This mixture is the pounce of the shops, and is almost insoluble in alcohol or turpentine. Dammar also largely takes the place of tender copal, gum anime, white amber, white incense, and white rosin. The latter three names are also often applied to a mixture of oil and Grecian wax, sometimes used in varnish. When gum dammar is used as the main rosin in a varnish, it should be first fused and brought to a boiling point, but not thawed. This eliminates the property that renders dammar varnish soft and "tacky" if not treated as above.

Venetian turpentine has a tendency to render varnish "tacky" and must be skillfully counteracted if this effect is to be avoided. Benzoin in varnish exposed to any degree of dampness has a ten-

dency to swell, and must in such cases be avoided. Elemi, a fragrant rosin from Egypt, in time grows hard and brittle, and is not so soluble in alcohol as anime, which is highly esteemed for its more tender qualities. Copal is a name given rather indiscriminately to various gums and rosins. The East Indian or African is the tender copal, and is softer and more transparent than the other varieties; when pure it is freely soluble in oil of turpentine or rosemary. Hard copal comes in its best form from Mexico, and is not readily soluble in oil unless first fused. The brilliant, deep-red color of old varnish is said to be based on dragon's blood, but not the kind that comes in sticks, cones, etc. (which is always adulterated), but the clear, pure tear, deeper in color than a carbuncle, and as crystal as a ruby. This is seldom seen in the market, as is also the tear of gamboge, which, mixed with the tear of dragon's blood, is said to be the basis of the brilliant orange and gold varnish of the ancients.

Of all applications used to adorn and protect the surface of objects, oil varnishes or lacquers containing hard rosins are the best, as they furnish a hard, glossy coating which does not crack and is very durable even when exposed to wind and rain.

To obtain a varnish of these desirable qualities the best old linseed oil, or varnish made from it, must be combined with the residue left by the dry distillation of amber or very hard copal. This distillation removes a quantity of volatile oil amounting to one-fourth or one-fifth of the original weight. The residue is pulverized and dissolved in hot linseed-oil varnish, forming a thick, viscous, yellow-brown liquid, which, as a rule, must be thinned with oil of turpentine before being applied.

Hard rosin oil varnish of this sort may conveniently be mixed with the solution of asphalt in the oil of turpentine with the aid of the simple apparatus described below, as the stiffness of the two liquids makes hand stirring slow and laborious. A cask is mounted on an axle which projects through both heads, but is inclined to the axis of the cask, so that when the ends of the axle are set in bearings and the cask is revolved, each end of the cask will rise and fall alternately, and any liquid which only partly fills the cask will be thoroughly mixed and churned in a short time. The cask is two-thirds filled with the two thick varnishes (hard rosin in linseed oil and asphalt in the oil of turpentine) in the desired proportion, and after these have been intimately mixed by turning the cask, a sufficient quantity of rectified oil of turpentine to give proper consistence is added and the rotation is continued until the mixture is perfectly uniform.

To obtain the best and most durable result with this mixed oil, rosin, and asphalt varnish it is advisable to dilute it freely with oil of turpentine and to apply 2 or 3 coats, allowing each coat to dry before the next is put on. In this way a deep black and very glossy surface is obtained which cannot be distinguished from genuine Japanese lacquer.

Many formulas for making these mixed asphalt varnishes contain rosin—usually American rosin. The result is the production of a cheaper but inferior varnish. The addition of such soft rosins as elemi and copaiba, however, is made for another reason, and it improves the quality of the varnish for certain purposes. Though these rosins soften the lacquer, they also make it more elastic, and therefore more suitable for coating leather and textile fabrics, as it does not crack in consequence of repeated bending, rolling, and folding.

In coloring spirit varnish the alcohol should always be colored first to the desired shade before mixing with the rosin, except where ivory or bone black is used. If the color is taken from a gum, due allowance for the same must be made in the rosins of the varnish. For instance, in a varnish based on mastic, 10 parts, and tender copal, 5 parts, in 100 parts, if this is to be colored with, say, 8 parts of dragon's blood (or any other color gum), the rosins must be reduced to mastic, 8 parts, and tender copal, 4 parts. Eight parts of color gum are here equivalent to 3 parts of varnish rosin. This holds true with gamboge, aloes, myrrh, and the other gum rosins used for their color. This seeming disproportion is due to the inert matter and gum insoluble in alcohol, always present in these gum rosins.

Shellac Varnish.—This is made in the general proportion of 3 pounds of shellac to a gallon of alcohol, the color, temper, etc., to be determined by the requirements of the purchaser, and the nature of the wood to which the varnish is to be applied. Shellac varnish is usually tempered with sandarac, elemi, dammar, and the oil of linseed, turpentine, spike, or rosemary.

Various impurities held in suspension in shellac varnish may be entirely precipitated by the gradual addition of some

crystals of oxalic acid, stirring the varnish to aid their solution, and then setting it aside overnight to permit the impurities to settle. No more acid should be used than is really necessary.

Rules for Varnishing.—1. Avoid as far as possible all manipulations with the varnishes; do not dilute them with oil of turpentine, and least of all with siccative, to expedite the drying. If the varnish has become too thick in consequence of faulty storing, it should be heated and receive an addition of hot, well-boiled linseed-oil varnish and oil of turpentine. Linseed-oil varnish or oil of turpentine added to the varnish at a common temperature renders it streaky (flacculent) and dim and has an unfavorable influence on the drying; oil of turpentine takes away the gloss of varnish.

2. Varnishing must be done only on smooth, clean surfaces, if a fine, mirror-like gloss is desired.

3. Varnish must be poured only into clean vessels, and from these never back into the stationary vessels, if it has been in contact with the brush. Use only dry brushes for varnishing, which are not moist with oil of turpentine or linseed oil or varnish.

4. Apply varnishes of all kinds as uniformly as possible; spread them out evenly on the surfaces so that they form neither too thick nor too thin a layer. If the varnish is put on too thin the coating shows no gloss; if applied too thick it does not get even and does not form a smooth surface, but a wavy one.

5. Like all oil-paint coatings, every coat of varnish must be perfectly dry before a new one is put on; otherwise it is likely that the whole work will show cracks. The consumer of varnish is only too apt to blame the varnish for all defects which appear in his work or develop after some time, although this can only be proven in rare cases. As a rule, the ground was not prepared right and the different layers of paint were not sufficiently dry, if the surfaces crack after a comparatively short time and have the appearance of maps. The cracking of paint must not be confounded with the cracking of the varnish, for the cracking of the paint will cause the varnish to crack prematurely. The varnish has to stand more than the paint; it protects the latter, and as it is transparent, the defects of the paint are visible through the varnish, which frequently causes one to form the erroneous conclusion that the varnish has cracked.

6. All varnish coatings must dry slowly, and during the drying must be absolutely protected from dust, flies, etc., until they have reached that stage when we can pass the back of the hand or a finger over them without sticking to it.

The production of faultless varnishing in most cases depends on the accuracy of the varnisher, on the treatment of his brush, his varnish pot, and all the other accessories. A brush which still holds the split points of the bristles never varnishes clear; they are rubbed off easily and spoil the varnished work. A brush which has never been used does not produce clean work; it should be tried several times, and when it is found that the varnishing accomplished by its use is neat and satisfactory it should be kept very carefully.

The preservation of the brush is thus accomplished: First of all do not place it in oil or varnish, for this would form a skin, parts of which would adhere to it, rendering the varnished surface unclean and grainy; besides these skins there are other particles which accumulate in the corners and cannot be removed by dusting off; these will also injure the work. In order to preserve the brush properly, insert it in a glass of suitable size through a cork in the middle of which a hole has been bored exactly fitting the handle. Into the glass pour a mixture of equal parts of alcohol and oil of turpentine, and allow only the point of the brush to touch the mixture, if at all. If the cork is air-tight the brush cannot dry in the vapor of oil of turpentine and spirit. From time to time the liquids in the glass should be replenished.

If the varnish remains in the varnish receptacle, a little alcohol may be poured on, which can do the varnish no harm. At all events the varnish will be prevented from drying on the walls of the vessel and from becoming covered by a skin which is produced by the linseed oil, and which indicates that the varnish is both fat and permanent. No skin forms on a meager varnish, even when it drys thick.

After complete drying of the coat of varnish it sometimes happens that the varnish becomes white, blue, dim, or blind. If varnish turns white on exposure to the air the quality is at fault. The varnish is either not fat enough or it contains a rosin unsuitable for exterior work (copal). The whitening occurs a few days after the drying of the varnish and can be removed only by rubbing off the varnish.

Preventing Varnish from Crawling.—Rub down the surface to be varnished

with sharp vinegar. Coating with strongly diluted ox gall is also of advantage.

Amber Varnish.—This varnish is capable of giving a very superior polish or surface, and is especially valuable for coach and other high-class work. The amber is first bleached by placing a quantity—say about 7 pounds—of yellow amber in a suitable receptacle, such as an earthenware crucible, of sufficient strength, adding 14 pounds of sal gemmæ (rock or fossil salt), and then pouring in as much spring water as will dissolve the sal gemmæ. When the latter is dissolved more water is added, and the crucible is placed over a fire until the color of the amber is changed to a perfect white. The bleached amber is then placed in an iron pot and heated over a common fire until it is completely dissolved, after which the melting pot is removed from the fire, and when sufficiently cool the amber is taken from the pot and immersed in spring water to eliminate the sal gemmæ, after which the amber is put back into the pot and is again heated over the fire till the amber is dissolved. When the operation is finished the amber is removed from the pot and spread out upon a clean marble slab to dry until all the water has evaporated, and is afterwards exposed to a gentle heat to entirely deprive it of humidity.

Asphalt Varnishes.—Natural asphalt is not entirely soluble in any liquid. Alcohol dissolves only a small percentage of it, ether a much larger proportion. The best solvents are benzol, benzine, rectified petroleum, the essential oils, and chloroform, which leave only a small residue undissolved. The employment of ether as a solvent is impracticable because of its low boiling point, 97° F., and great volatility. The varnish would dry almost under the brush. Chloroform is not open to this objection, but it is too expensive for ordinary use. Rectified petroleum is a good solvent of asphalt, but it is not a desirable ingredient of varnish because, though the greater part of it soon evaporates, a small quantity of less volatile substances, which is usually present in even the most thoroughly rectified petroleum, causes the varnish to remain "tacky" for a considerable time and to retain a disagreeable odor much longer. Common coal-tar benzine is also a good solvent and has the merit of cheapness, but its great volatility makes the varnish dry too quickly for convenient use, especially in summer. The best solvent, probably, is oil of turpentine, which dissolves asphalt almost completely, producing a varnish which dries quickly and forms a perfect coating if the turpentine has been well rectified. The turpentine should be a "water white," or entirely colorless, liquid of strong optical refractive power and agreeable odor, without a trace of smokiness. A layer ⅛ of an inch in depth should evaporate in a short time so completely as to leave no stain on a glass dish.

But even solutions of the best Syrian asphalt in the purest oil of turpentine, if they are allowed to stand undisturbed for a long time in large vessels, deposit a thick, semi-fluid precipitate which a large addition of oil of turpentine fails to convert into a uniform thin liquid. It may be assumed that this deposit consists of an insoluble or nearly insoluble part of the asphalt which, perhaps, has been deprived of solubility by the action of light. Hence, in order to obtain a uniform solution, this thick part must be removed. This can be done, though imperfectly, by carefully decanting the solution after it has stood for a long time in large vessels. This tedious and troublesome process may be avoided by filtering the solution as it is made, by the following simple and quite satisfactory method: The solution is made in a large cask, lying on its side, with a round hole about 8 inches in diameter in its upper bilge. This opening is provided with a well-fitting cover, to the bottom of which a hook is attached. The asphalt is placed in a bag of closely woven canvas, which is inclosed in a second bag of the same material. The diameter of the double bag, when filled, should be such as to allow it to pass easily through the opening in the cask, and its length such that, when it is hung on the hook, its lower end is about 8 inches above the bottom of the cask. The cask is then filled with rectified oil of turpentine, closed, and left undisturbed for several days. The oil of turpentine penetrates into the bag and dissolves the asphalt, and the solution, which is heavier than pure oil of turpentine, exudes through the canvas and sinks to the bottom of the cask. Those parts of the asphalt which are quite insoluble, or merely swell in the oil of turpentine, cannot pass through the canvas, and are removed with the bag, leaving a perfect solution. When all soluble portions have been dissolved, the bag, with the cover, is raised and hung over the opening to drain. If pulverized asphalt has

been used the bag is found to contain only a small quantity of semi-fluid residue. This, thinned with oil of turpentine and applied with a stiff brush and considerable force, forms a thick, weather-resisting, and very durable coating for planks, etc.

The proportion of asphalt to oil of turpentine is so chosen as to produce, in the cask, a pretty thick varnish, which may be thinned to any desired degree by adding more turpentine. For use, it should be just thick enough to cover bright tin and entirely conceal the metal with a single coat. When dry, this coat is very thin, but it adheres very firmly, and continually increases in hardness, probably because of the effect of light. This supposition is supported by the difficulty of removing an old coat of asphalt varnish, which will not dissolve in turpentine even after long immersion, and usually must be removed by mechanical means.

For a perfect, quick-drying asphalt varnish the purest asphalt must be used, such as Syrian, or the best Trinidad. Trinidad seconds, though better than some other asphalts, yield an inferior varnish, owing to the presence of impurities.

Of artificial asphalt, the best for this purpose is the sort known as "mineral caoutchouc," which is especially suitable for the manufacture of elastic dressings for leather and other flexible substances. For wood and metal it is less desirable, as it never becomes as hard as natural asphalt.

FORMULAS:

I.—A solution of 1 part of caoutchouc in 16 parts of oil of turpentine or kerosene is mixed with a solution of 16 parts of copal in 8 parts of linseed-oil varnish. To the mixture is added a solution of 2 parts of asphalt in 3 or 4 parts of linseed-oil varnish diluted with 8 or 10 parts of oil of turpentine, and the whole is filtered. This is a fine elastic varnish.

II.—Coal-tar asphalt, American asphalt, rosin, benzine, each 20 parts; linseed-oil varnish, oil of turpentine, coal-tar oil, each 10 parts; binoxide of manganese, roasted lampblack, each 2 parts. The solid ingredients are melted together and mixed with the linseed-oil varnish, into which the lampblack has been stirred, and, finally, the other liquids are added. The varnish is strained through tow.

Bicycle Varnish.—This is a spirit varnish, preferably made by a cold process, and requires less technical knowledge than the preparation of fatty varnishes. The chief dependence is upon the choice of the raw materials. These raw materials, copal, shellac, etc., are first broken up small and placed in a barrel adapted for turning upon an axis, with a hand crank, or with a belt and pulley from a power shaft. The barrel is of course simply mounted in a frame of wood or iron, whichever is the most convenient. After the barrel has received its raw material, it may be started and kept revolving for 24 hours. Long interruptions in the turning must be carefully avoided, particularly in summer, for the material in the barrel, when at rest, will, at this season, soon form a large lump, to dissolve which will consume much time and labor. To prevent the formation of a semi-solid mass, as well as to facilitate the dissolving of the gum, it would be well to put some hard, smooth stones into the barrel with the varnish ingredients.

Bicycle Dipping Varnish (Baking Varnish).—Take 50 parts, by weight, of Syrian asphalt; 50 parts, by weight, of copal oil; 50 parts, by weight, of thick varnish oil, and 105 parts, by weight, turpentine oil, to which add 7 parts, by weight, of drier. When the asphalt is melted through and through, add the copal oil and heat it until the water is driven off, as copal oil is seldom free from water. Now take it off the fire and allow it to cool; add first the siccative, then the turpentine and linseed oil, which have been previously thoroughly mixed together. This bicycle varnish does not get completely black until it is baked.

Black Varnishes.—Black spirit lacquers are employed in the wood and metal industries. Different kinds are produced according to their use. They are called black Japanese varnishes, or black brilliant varnishes.

Black Japanese Varnish.—I.—Sculpture varnish, 5 parts; red acaroid varnish, 2 parts; aniline black, ¼ part; Lyons blue, .0015 parts. If a sculpture varnish prepared with heated copal is employed, a black lacquer of especially good quality is obtained. Usually 1 per cent of oil of lavender is added.

II.—Shellac	4 parts
Borax	2 parts
Glycerine	2 parts
Aniline black	5 parts
Water	50 parts

Dissolve the borax in the water, add

the shellac, and heat until solution is effected; then add the other ingredients. This is a mat-black varnish.

For Blackboards.—For blackening these boards mix ½ liter (1.05 pints) good alcohol, 70 grams (1,080 grains) shellac, 6 grams (92 grains) fine lampblack, 3 grams (46 grains) fine chalk free from sand. If red lines are to be drawn, mix the necessary quantity of red lead in alcohol and shellac.

Bookbinders' Varnishes.—

	I Per Cent	II Per Cent	III Per Cent	IV Per Cent	V Per Cent
Shellac	14.5	6.5	13.5	6.3	8.3
Mastic	6.0	2.0	..	..	1.1
Sandarac	6.0	13.0	..	1.3	1.1
Camphor	1.0	..	0.5	1.5	..
Benzoin	..	..	..	..	13.7
Alcohol	72.5	78.5	86.0	79.2	75.8

Scent with oil of benzoin, of lavender, or of rosemary. Other authors give the following recipes:

	VI Per Cent	VII Per Cent	VIII Per Cent	IX Per Cent
Blond shellac	11.5	13.0	9.0	..
White shellac	11.5	..	..	..
Camphor	..	0.7	..	..
Powdered sugar	..	0.7	..	..
Sandarac	..	..	18.0	6.6
Mastic	..	..	..	13.0
Venice turpentine	..	..	2.0	6.6
Alcohol	77.0	85.6	71.0	73.8

All solutions may be prepared in the cold, but the fact that mastic does not dissolve entirely, must not be lost sight of.

Bottle Varnish.—Bottles may be made to exclude light pretty well by coating them with asphaltum lacquer or varnish. A formula recommended for this purpose is as follows: Dissolve asphaltum, 1 part, in light coal-tar oil, 2 parts, and add to the solution about 1 per cent of castor oil. This lacquer dries somewhat slowly, but adheres very firmly to the glass. Asphaltum lacquer may also be rendered less brittle by the addition of elemi. Melt together asphaltum, 10 parts, and elemi, 1 part, and dissolve the cold fused mass in light coal-tar oil, 12 parts.

Amber-colored bottles for substances acted upon by the actinic rays of light may be obtained from almost any manufacturer of bottles.

Can Varnish.—Dissolve shellac, 15 parts, by weight; Venice turpentine, 2 parts, by weight; and sandarac, 8 parts, by weight, in spirit, 75 parts, by weight.

Copal Varnish.—Very fine copal varnish for those parts of carriages which require the highest polish, is prepared as follows:

I.—Melt 8 pounds best copal and mix with 20 pounds very clear matured oil. Then boil 4 to 5 hours at moderate heat until it draws threads; now mix with 35 pounds oil of turpentine, strain and keep for use. This varnish dries rather slowly, therefore varnishers generally mix it one-half with another varnish, which is prepared by boiling for 4 hours, 20 pounds clear linseed oil and 8 pounds very pure, white anime rosin, to which is subsequently added 35 pounds oil of turpentine.

II.—Mix the following two varnishes:

(*a*) Eight pounds copal, 10 pounds linseed oil, ½ pound dried sugar of lead, 35 pounds oil of turpentine.

(*b*) Eight pounds good anime rosin, 10 pounds linseed oil, ¼ pound zinc vitriol, 35 pounds oil of turpentine. Each of these two sets is boiled separately into varnish and strained, and then both are mixed. This varnish dries in 6 hours in winter, and in 4 hours in summer. For old articles which are to be re-varnished black, it is very suitable.

Elastic Limpid Gum Varnishes.—I.—In order to obtain a limpid rubber varnish, it is essential to have the rubber entirely free from water. This can be obtained by cutting the rubber into thin strips, or better, into shreds as fine as possible, and drying them, at a temperature of from 104° to 122° F., for several days or until they are water free, then proceed as follows:

II.—Dissolve 1 part of the desiccated rubber in 8 parts of petroleum ether (benzine) and add 2 parts of fat copal varnish and stir in. Or, cover 2 parts of dried rubber with 1 part of ether; let stand for several days, or until the rubber has taken up as much of the ether as it will, then liquefy by standing in a vessel of moderately warm water. While still warm, stir in 2 parts of linseed oil, cut with 2 parts of turpentine oil.

ENAMEL VARNISHES:

Antiseptic Enamel.—This consists of a solution of spirituous gum lac, rosin, and copal, with addition of salicylic acid, etc. Its purpose is mainly the prevention or removal of mold or fungous formation. The salicylic acid contained in the mass acts as an antiseptic during the painting, and destroys all fungi present.

Bath-Tub Enamel Unaffected by Hot Water.—I.—In order to make paint hold on the zinc or tinned copper lining of a bath tub, a wash must be used to produce a film to which oil paint will adhere. First remove all grease, etc., with a solution of soda or ammonia and dry the surface thoroughly; then apply with a wide, soft brush equal parts, by weight, of chloride of copper, nitrate of copper, and sal ammoniac, dissolved in 64 parts, by weight, of water. When dissolved add 1 part, by weight, of commercial muriatic acid. This solution must be kept in glass or earthenware. It will dry in about 12 hours, giving a grayish-black coating to which paint will firmly adhere.

The priming coat should be white lead thinned with turpentine, with only just sufficient linseed oil to bind it. After this is thoroughly dry, apply one or more coats of special bath-tub enamel, or a gloss paint made by mixing coach colors ground in Japan with hard-drying varnish of the best quality. Most first-class manufacturers have special grades that will stand hot water.

II.—The following preparation produces a brilliant surface on metals and is very durable, resisting the effect of blows without scaling or chipping off, and being therefore highly suitable for cycles and any other articles exposed to shock:

For the manufacture of 44 gallons, 11 pounds of red copper, 8.8 pounds of yellow copper, 4.4 pounds of hard steel, and 4.4 pounds of soft steel, all in a comminuted condition, are well washed in petroleum or mineral spirit, and are then treated with concentrated sulphuric acid in a lead-lined vessel, with continued stirring for 2 hours. After 12 hours' rest the sulphuric acid is neutralized with Javel extract, and the fine powder left in the vessel is passed through a silk sieve to remove any fragments of metal, then ground along with linseed oil, ivory black, and petroleum, the finely divided mass being afterwards filtered through flannel and incorporated with a mixture of Bombay gum, 22 pounds· Damascus gum, 11 pounds; Judea bitumen, 22 pounds; Norwegian tar rosin, 11 pounds; and 11 pounds of ivory black ground very fine in refined petroleum. When perfectly homogeneous the mass is again filtered, and is then ready for use. It is laid on with a brush, and then fixed by exposure to a temperature of between 400° and 800° F. The ivory black may be replaced by other coloring matters, according to requirements.

A Color Enamel.—On the piece to be enameled apply oil varnish or white lead, and add a powder giving brilliant reflections, such as diamantine, brilliantine, or argentine. Dry in a stove. Apply a new coat of varnish. Apply the powder again, and finally heat in the oven. Afterwards, apply several layers of varnish; dry each layer in the oven. Apply pumice stone in powder or tripoli, and finally apply a layer of Swedish varnish, drying in the oven. This enamel does not crack. It adheres perfectly, and is advantageous for the pieces of cycles and other mobiles.

Cold Enameling.—This style of enameling is generally employed for repairing purposes. The various colors are either prepared with copal varnish and a little oil of turpentine, or else they are melted together with mastic and a trifle of oil of spike. In using the former, the surface usually settles down on drying, and ordinarily the latter is preferred, which is run on the cracked-off spot by warming the article. After the cooling, file the cold enamel off uniformly, and restore the gloss by quickly drawing it through the flame. For black cold enamel melt mastic together with lampblack, which is easily obtained by causing the flame of a wick dipped into linseed oil to touch a piece of tin.

White.—White lead or flake white.

Red.—Carmine or cinnabar (vermilion).

Blue.—Ultramarine or Prussian blue.

Green.—Scheele's green or Schweinfurt green.

Brown.—Umber.

Yellow.—Ocher or chrome yellow.

The different shades are produced by mixing the colors.

Enamel for Vats, etc.—Two different enamels are usually employed, viz., one for the ground and one for the top, the latter being somewhat harder than the former. Ground enamel is prepared by melting in an enameled iron kettle 625 parts brown shellac, 125 parts French oil of turpentine, with 80 parts colophony, and warming in another vessel 4,500 parts of spirit (90 per cent). As soon as the rosins are melted, remove the pot from the fire and add the spirit in portions of 250 parts at a time, seeing to it that the spirit added is completely combined with the rosins by stirring before adding any more. When all the spirit is added, warm the whole again for several minutes on the water bath (free fire should

be avoided, on account of danger of fire), and allow to settle. If a yellow color is desired, add yellow ocher, in which case the mixture may also be used as floor varnish.

The top enamel (hard) consists of 500 parts shellac, 125 parts French oil of turpentine, and 3,500 parts spirit (90 per cent). Boiling in the water bath until the solution appears clear can only be of advantage. According to the thickness desired, one may still dilute in the cold with high-strength spirit. Tinting may be done, as desired, with earth colors, viz., coffee brown with umber, red with English red, yellow with ocher, silver gray with earthy cerussite, and some lampblack. Before painting, dry out the vats and putty up the joints with a strip of dough which is prepared from ground enamel and finely sifted charcoal or brown coal ashes, and apply the enamel after the putty is dry. The varnish dries quickly, is odorless and tasteless, and extraordinarily durable. If a little annealed soot black is added to this vat enamel, a fine iron varnish is obtained which adheres very firmly. Leather (spattering leather on carriages) can also be nicely varnished with it.

Finishing Enamel for White Furniture.—Various methods are practiced in finishing furniture in white enamel, and while numerous preparations intended for the purpose named are generally purchasable of local dealers in paint supplies, it is often really difficult, and frequently impossible, to obtain a first-class ready-made enamel. To prepare such an article take ½ pint of white lead and add to it ½ pint of pure turpentine, ¼ gill of pale coach Japan, and ½ gill of white dammar varnish. Mix all the ingredients together thoroughly. Apply with a camel's-hair brush, and for large surfaces use a 2-inch double thick brush. There should be at least three coats for good work, applied after an interval of 24 hours between coats; and for strictly high-class work four coats will be necessary. Each coat should be put on thin and entirely free from brush marks, sandpapering being carefully done upon each coat of pigment. Work that has been already painted or varnished needs to be cut down with, say, No. ½ sandpaper, and then smoothed fine with No. ½ paper. Then thin white lead to a free working consistency with turpentine, retaining only a weak binder of oil in the pigment, and apply two coats of it to the surface. Give each coat plenty of time to harden (36 hours should suffice), after which sandpapering with No. 1½ paper had best be done. Ordinarily, upon two coats of white lead, the enamel finish, as above detailed, may be successfully produced. For the fine, rich enamel finish adapted to rare specimens of furniture and developed in the mansions of the multimillionaires, a more elaborate and complex process becomes necessary.

Quick-Drying Enamel Colors.—Enamel colors which dry quickly, but remain elastic so that applied on tin they will stand stamping without cracking off, can be produced as follows:

In a closed stirrer or rolling cask place 21.5 parts, by weight, of finely powdered pale French rosin, 24½ parts, by weight, of Manila copal, as well as 35 parts, by weight, of denaturized spirit (95 per cent), causing the cask or the stirrer to rotate until all the gum has completely dissolved, which, according to the temperature of the room in which the stirrer is and the hardness of the gums, requires 24 to 48 hours. When the gums are entirely dissolved add to the mixture a solution of 21½ parts, by weight, of Venice oil turpentine in 0.025 parts, by weight, of denaturized spirit of 95 per cent, allowing the stirrer to run another 2 to 3 hours. For the purpose of removing any impurities present or any undissolved rosin from the varnish, it is poured through a hair sieve or through a threefold layer of fine muslin (organdie) into suitable tin vessels or zinc-lined barrels for further clarification. After 10 to 14 days the varnish is ready for use. By grinding this varnish with the corresponding dry pigments the desired shades of color may be obtained; but it is well to remark that chemically pure zinc white cannot be used with advantage because it thickens and loses its covering power. The grinding is best carried out twice on an ordinary funnel mill. Following are some recipes:

I.—**Enamel White.**—Lithopone, 2 parts, by weight; white lead, purest, ½ part, by weight; varnish, 20 parts, by weight.

II.—**Enamel Black.**—Ivory black, 2 parts, by weight; Paris blue, 0.01 part, by weight; varnish, 23 parts, by weight.

III.—**Pale Gray.**—Graphite, 2 parts, by weight; ultramarine, 0.01 part, by weight; lithopone, 40 parts, by weight; varnish, 100 parts, by weight.

IV.—**Dark Gray.**—Graphite, 3 parts, by weight; ivory black, 2 parts, by weight; lithopone, 40 parts, by weight; varnish, 110 parts, by weight.

V.—**Chrome Yellow, Pale.**—Chrome yellow, 2 parts, by weight; lithopone, 2 parts, by weight; varnish, 40 parts, by weight; benzine, 1½ parts, by weight.

VI.—**Chrome Yellow, Dark.**—Chrome yellow, dark, 2 parts, by weight; chrome orange, ⅛ part, by weight; lithopone, 1 part, by weight; varnish, 35 parts, by weight; benzine, 1 part, by weight.

VII.—**Pink, Pale.**—Carmine, ½ part, by weight; lithopone, 15 parts, by weight; varnish, 40 parts, by weight; benzine, 1½ parts, by weight.

VIII.—**Pink, Dark.**—Carmine, ½ part, by weight; Turkey red, 1 part, by weight; lithopone, 15 parts, by weight; varnish, 40 parts, by weight.

IX.—**Turkey Red.**—Turkey red, pale, 2 parts, by weight; lithopone, 1 part, by weight; Turkey red, dark, 1 part, by weight; white lead, pure, ½ part, by weight; varnish, 18 parts, by weight; benzine, ½ part, by weight.

X.—**Flesh Tint.**—Chrome yellow, pale, 1½ parts, by weight; graphite, ⅛ part, by weight; lithopone, 15 parts, by weight; Turkey red, pale, 2 parts, by weight; varnish, 42 parts, by weight; benzine, ½ part, by weight.

XI.—**Carmine Red.**—Lead sulphate, 5 parts, by weight; Turkey red, pale, 6 parts, by weight; carmine, 1½ parts, by weight; orange minium, 3 parts, by weight; vermilion, 2 parts, by weight; varnish, 50 parts, by weight; benzine, 1½ parts, by weight.

XII.—**Sky Blue.**—Ultramarine, 5 parts, by weight; lithopone, 5 parts, by weight; ultramarine green, 0.05 parts, by weight; varnish, 30 parts, by weight; benzine, 1 part, by weight.

XIII.—**Ultramarine.**—Ultra blue, 5 parts, by weight; varnish, 12 parts, by weight; benzine, ½ part, by weight.

XIV.—**Violet.**—Ultramarine, with red tinge, 10 parts, by weight; carmine, 0.5 parts, by weight; varnish, 25 parts, by weight.

XV.—**Azure.**—Paris blue, 10 parts, by weight; lithopone, 100 parts, by weight; varnish, 300 parts, by weight.

XVI.—**Leaf Green.**—Chrome green, pale, 5 parts, by weight; varnish, 25 parts, by weight; benzine, ½ part, by weight.

XVII.—**Silk Green.**—Silk green, 10 parts, by weight; chrome yellow, pale, ½ part, by weight; lead sulphate, 5 parts, by weight; varnish, 30 parts, by weight; benzine, ½ part, by weight.

XVIII.—**Brown.**—English red, 10 parts, by weight; ocher, light, 3 parts, by weight; varnish, 30 parts, by weight; benzine, ½ part, by weight.

XIX.—**Ocher.**—French ocher, 10 parts, by weight; chrome yellow, dark, ½ part, by weight; varnish, 30 parts, by weight; benzine, ½ part, by weight.

XX.—**Chocolate.**—Umber, 10 parts, by weight; Florentine lake, ⅛ part, by weight; varnish, 25 parts, by weight; benzine, ½ part, by weight.

XXI.—**Terra Cotta.**—Chrome yellow, pale, 10 parts, by weight; Turkey red, dark, 3 parts, by weight; varnish, 35 parts, by weight.

XXII.—**Olive, Greenish.**—French ocher, 5 parts, by weight; Paris blue, ½ part, by weight; graphite, ½ part, by weight; varnish, 25 parts, by weight; lithopone, 5 parts, by weight.

XXIII.—**Olive, Brownish.**—Chrome orange, 5 parts, by weight; Paris blue, 2 parts, by weight; lead sulphate, 10 parts, by weight; English red, 1 part, by weight; varnish, 40 parts, by weight; benzine, 1½ parts, by weight.

XXIV.—**Olive, Reddish.**—Turkey red, dark, 75 parts, by weight; sap green, 75 parts, by weight; ocher, pale, 5 parts, by weight; varnish, 300 parts, by weight; benzine, 1½ parts, by weight.

ENGRAVERS' VARNISHES.

In copper-plate engraving the plate must be covered with a dark-colored coating which, though entirely unaffected by the etching fluid, must be soft enough to allow the finest lines to be drawn with the needle and must also be susceptible of complete and easy removal when the etching is finished. Varnishes which possess these properties are called "etching grounds." They are made according to various formulas, but in all cases the principal ingredient is asphalt, of which only the best natural varieties are suitable for this purpose. Another common ingredient is beeswax, or tallow.

Etching grounds are usually made in small quantities, at a single operation, by melting and stirring the solid ingredients together and allowing the mass to cool in thin sheets, which are then dissolved in oil of turpentine. The plate is coated uniformly with this varnish through which the engraver's tool readily penetrates, laying bare the metal beneath. After the lines thus drawn have been etched by immersing the plate in acid, the varnish is washed off with oil of turpentine.

The following formulas for etching grounds have been extensively used by engravers:

	I	II	III	IV
Yellow wax	50	30	110	40 parts
Syrian asphalt	20	20	25	40 parts
Rosin		..	..	20 parts
Amber		..	20	.. parts
Mastic	25	25	25	.. parts
Tallow		..	..	2 parts
Bergundy pitch		..	..	10 parts

FLOOR VARNISHES.

I.—Manila copal, spirit-soluble .... 12 parts
Ruby shellac, powdered .... 62 parts
Venice, turpentine .... 12 parts
Spirit, 96 per cent .... 250 parts

The materials are dissolved cold in a covered vat with constant stirring, or better still, in a stirring machine, and filtered. For the pale shades take light ocher; for dark ones, Amberg earth, which are well ground with the varnish in a paint mill.

II.—Shellac, A C leaf, 1.2 parts; sandarac, 8 parts; Manila copal, 2 parts; rosin, 5 parts; castor or linoleic acid or wood oil acid, 1.50 parts; spirit (96 per cent), 65 parts.

French Varnish.—So-called French varnish is made by dissolving 1 part of bleached or orange shellac in 5 parts of alcohol, the solution being allowed to stand and the clear portion then being decanted. The varnish may be colored by materials which are soluble in alcohol.

For red, use 1 part of eosin to 49 parts of the bleached shellac solution. For blue, use 1 part of aniline blue to 24 parts of the bleached shellac solution, as the orange shellac solution would impart a greenish cast. For green, use 1 part of aniline green (brilliant green) to 49 parts of the orange shellac solution. For yellow, use either 2 parts of extract of turmeric or 1 part of gamboge to 24 parts of the solution, or 1 part of aniline yellow to 49 parts of the solution. For golden yellow, use 2 parts of gamboge and 1 part of dragon's blood to 47 parts of the orange shellac solution. The gamboge and dragon's blood should be dissolved first in a little alcohol.

Golden Varnishes.—

I.—Powdered benzoin.. 1 part
Alcohol enough to make 10 parts.
Pure saffron, roughly broken up, about 6 threads to the ounce.

Macerate 3 days and filter. Vary the quantity of saffron according to the shade desired. Mastic and juniper gum may be added to this varnish if a heavier body is desired.

II.—Benzoin, juniper gum, gum mastic, equal parts.

Dissolve the gums in 9 times their weight of alcohol (varied more or less according to the consistency wanted), and color to the desired shade with threads of pure saffron. This varnish is very brilliant and dries at once.

India-Rubber Varnishes.—I.—Dissolve 10 pounds of India rubber in a mixture of 10 pounds of turpentine and 20 pounds of petroleum by treating same on a water bath. When the solution is completed add 45 pounds of drying oil and 5 pounds of lampblack and mix thoroughly.

II.—Dissolve 7 pounds of India rubber in 25 pounds of oil of turpentine. By continued heating dissolve 14 pounds of rosin in the mixture. Color while hot with 3 pounds of lampblack.

Inlay Varnish.—

Ozokerite .... 17 parts
Carnauba wax .... 3 parts
Turpentine oil .... 15 parts

Melt the ozokerite and Carnauba wax, then stir in the turpentine oil. This varnish is applied like a polish and imparts to the wood a dark natural color and a dull luster.

Japanning Tin.—The first thing to be done when a vessel is to be japanned, is to free it from all grease and oil, by rubbing it with turpentine. Should the oil, however, be linseed, it may be allowed to remain on the vessel, which must in that case be put in an oven and heated till the oil becomes quite hard.

After these preliminaries, a paint of the shade desired, ground in linseed oil, is applied. For brown, umber may be used.

When the paint has been satisfactorily applied it should be hardened by heating, and then smoothed down by rubbing with ground pumice stone applied gently by means of a piece of felt moistened with water. To be done well, this requires care and patience, and, it might be added, some experience.

The vessel is next coated with a varnish, made by the following formula:

Turpentine spirit .... 8 ounces
Oil of lavender ...... 6 ounces
Camphor .... 1 drachm
Bruised copal .... 2 ounces

Perhaps some other good varnish would give equally satisfactory results.

After this the vessel is put in an oven and heated to as high a temperature as it will bear without causing the varnish to

blister or run. When the varnish has become hard, the vessel is taken out and another coat is put on, which is submitted to heat as before. This process may be repeated till the judgment of the operator tells him that it is no longer advisable.

Some operators mix the coloring matter directly with the varnish; when this is done, care should be taken that the pigment is first reduced to an impalpable powder, and then thoroughly mixed with the liquid.

LABEL VARNISHES.

I.—Sandarac	3	ounces av.
Mastic	$\frac{3}{4}$	ounce av.
Venice turpentine	150	grains
Alcohol	16	fluidounces

Macerate with repeated stirring until solution is effected, and then filter.

The paper labels are first sized with diluted mucilage, then dried, and then coated with this varnish. If the labels have been written with water-soluble inks or color, they are first coated with 2 coats of collodion, and then varnished.

II.—The varnished labels of stock vessels often suffer damage from the spilling of the contents and the dripping after much pouring.

Formalin gelatin is capable of withstanding the baneful influence of ether, benzine, water, spirit of wine, oil, and most substances. The following method of applying the preservative is recommended: Having thoroughly cleaned the surface of the vessel, paste the label on and allow it to dry well. Give it a coat of thin collodion to protect the letters from being dissolved out or caused to run, then after a few minutes paint over it a coat of gelatin warmed to fluidity—5 to 25—being careful to cover in all the edges. Just before it solidifies go over it with a tuft of cotton dipped into a 40 per cent formalin solution. It soon dries and becomes as glossy as varnish, and may be coated again and again without danger of impairing the clear white of the label or decreasing its transparency.

Leather Varnishes.—I.—An excellent varnish for leather can be made from the following recipe: Heat 400 pounds of boiled oil to 212° F., and add little by little 2 pounds of bichromate of potash, keeping the same temperature. The addition of the bichromate should take about 15 minutes. Raise to 310° F., and add gradually during 1 hour at that temperature, 40 pounds Prussian blue. Heat for 3 hours more, gradually raising to 482° to 572° F., with constant stirring. In the meantime, heat together at 392° F., for ½ an hour, 25 pounds linseed oil, 35 pounds copal, 75 pounds turpentine, and 7 pounds ceresine. Mix the two varnishes, and dilute, if necessary, when cold with turpentine. The varnish should require to be warmed for easy application with the brush.

II.—Caoutchouc, 1 part; petroleum, 1 part; carbon bisulphide, 1 part; shellac, 4 parts; bone black, 2 parts; alcohol, 20 parts. First the caoutchouc is brought together with carbon bisulphide in a well-closed bottle and stood aside for a few days. As soon as the caoutchouc is soaked add the petroleum and the alcohol, then the finely powdered shellac, and heat to about 125° F. When the liquid appears pretty clear, which indicates the solution of all substances, the bone black is added by shaking thoroughly and the varnish is at once filled in bottles which are well closed. This pouch composition excels in drying quickly and produces upon the leather a smooth, deep black coating, which possesses a certain elasticity.

METAL VARNISHES.

The purpose of these varnishes is to protect the metals from oxidation and to render them glossy.

Aluminum Varnish.—The following is a process giving a special varnish for aluminum, but it may also be employed for other metals, giving a coating unalterable and indestructible by water or atmospheric influences: Dissolve, preferably in an enameled vessel, 10 parts, by weight, of gum lac in 30 parts of liquid ammonia. Heat on the water bath for about 1 hour and cool. The aluminum to be covered with this varnish is carefully cleaned in potash, and, having applied the varnish, the article is placed in a stove, where it is heated, during a certain time, at a suitable temperature (about 1062° F.).

Brass Varnishes Imitating Gold.—I.—An excellent gold varnish for brass objects, surgical or optical instruments, etc., is prepared as follows: Gum lac, in grains, pulverized, 30 parts; dragon's blood, 1 part; red sanders wood, 1 part; pounded glass, 10 parts; strong alcohol, 600 parts; after sufficient maceration, filter. The powdered glass simply serves for accelerating the dissolving, by interposing between the particles of gum lac and opal.

II.—Reduce to powder, 160 parts, by weight, of turmeric of best quality, and pour over it 2 parts, by weight, of saffron,

and 1,700 parts, by weight, of spirit; digest in a warm place 24 hours, and filter. Next dissolve 80 parts, by weight, of dragon's blood; 80 parts, by weight, of sandarac; 80 parts, by weight, of elemi gum; 50 parts, by weight, of gamboge; 70 parts, by weight, of seedlac. Mix these substances with 250 parts, by weight, of crushed glass, place them in a flask, and pour over this mixture the alcohol colored as above described. Assist the solution by means of a sand or water bath, and filter at the close of the operation. This is a fine varnish for brass scientific instruments.

Bronze Varnishes.—I.—The following process yields a top varnish for bronze goods and other metallic ware in the most varying shades, the varnish excelling, besides, in high gloss and durability. Fill in a bottle, pale shellac, best quality, 40 parts, by weight; powdered Florentine lake, 12 parts, by weight; gamboge, 30 parts, by weight; dragon's blood, also powdered, 6 parts, by weight; and add 400 parts, by weight, of spirit of wine. This mixture is allowed to dissolve, the best way being to heat the bottle on the water bath until the boiling point of water is almost reached, shaking from time to time until all is dissolved. Upon cooling, decant the liquid, which constitutes a varnish of dark-red color, from any sediment that may be present. In a second bottle dissolve in the same manner 24 parts, by weight, of gamboge in 400 parts, by weight, of spirit of wine, from which will result a varnish of golden-yellow tint. According to the hue desired, mix the red varnish with the yellow variety, producing in this way any shade from the deepest red to the color of gold. If required, dilute with spirit of wine. The application of the varnish should be conducted as usual, that is, the article should be slightly warm, it being necessary to adhere strictly to a certain temperature, which can be easily determined by trials and maintained by experience. In order to give this varnish a pale-yellow to greenish-yellow tone, mix 10 drops of picric acid with about 3 parts, by weight, of spirit of wine, and add to a small quantity of the varnish some of this mixture until the desired shade has been reached. Picric acid is poisonous, and the keeping of varnish mixed with this acid in a closed bottle is not advisable, because there is danger of an explosion. Therefore, it is best to prepare only so much varnish at one time as is necessary for the immediate purpose.

Brown Varnish.—An excellent and quickly drying brown varnish for metals is made by dissolving 20 ounces of gum kino and 5 ounces of gum benjamin in 60 ounces of the best cold alcohol; 20 ounces of common shellac and 2 ounces of thick turpentine in 36 ounces of alcohol also give a very good varnish. If the brown is to have a reddish tint, dissolve 50 ounces of ruby shellac, 5 ounces balsam of copaiba, and 2 to 5 ounces of aniline brown, with or without ½ to 1 ounce of aniline violet, in 150 ounces of alcohol.

Copper Varnishes.—These two are for polished objects:

I.—One hundred and ten parts of sandarac and 30 parts of rosin, dissolved in sufficient quantity of alcohol; 5 parts of glycerine are to be added.

II.—Sandarac	10	parts
Rosin	3	parts
Glycerine	½	part
Alcohol, a sufficient quantity.		

Dissolve the two rosins in sufficient alcohol and add the glycerine.

Decorative Metal Varnishes.—

	I Per Cent	II Per Cent	III Per Cent	IV Per Cent
Seed lac	11.5	..	..	..
Amber	7.6	..	..	13.5
Gamboge	7.6	..	..	..
Dragon's blood	0.18	..	..	..
Saffron	0.16	..	..	..
Sandarac	..	11.2	15.9	16.6
Mastic	..	6.5	14.0	3.4
Elemi	..	3.3	..	..
Venice turpentine	..	..	1.0	3.4
Camphor	..	1.5	..	..
Aloe	..	..	7.0	..
Alcohol	72.96	77.5	66.1	63.2

As will be seen, only natural colors are used. The so-called "gold lacquer" is composed as follows: Sandarac, 6.25 parts; mastic, 3 parts; shellac, 12.5 parts; Venice turpentine, 2.5 parts; aloe, 0.75 parts; gamboge, 3 parts; alcohol, 72 parts. The solution is filtered. Applied in a thin coating this varnish shows a handsome golden shade. Other metal varnishes have the following composition:

	V Per Cent	VI Per Cent	VII Per Cent
Shellac	17.5	..	18.0
Yellow acaroid gum	13.1	25.0	..
Manila	..	8.0	9.0
Alcohol	69.4	67.0	63.0

Gold Varnish.—I.—A good gold varnish for coating moldings which produces great brilliancy is prepared as follows: Dissolve 3 pounds of shellac in 30 quarts of alcohol, 5 pounds of mastic in 5 quarts of alcohol, 3 pounds of sandarac in 5 quarts of alcohol, 5 pounds of gamboge in 5 quarts of alcohol, 1 pound of dragon's blood in 1 quart of alcohol, 3 pounds of saunders in 5 quarts of alcohol, 3 pounds of turpentine in 3 quarts of alcohol. After all the ingredients have been dissolved separately in the given quantity of absolute alcohol and filtered, the solutions are mixed at a moderate heat.

II.—A varnish which will give a splendid luster, and any gold color from deep red to golden yellow, is prepared by taking 50 ounces pale shellac, 15 pounds Florentine lake (precipitated from cochineal or redwood decoction by alum onto strach, kaolin, or gypsum), 25 ounces of sandalwood, and 8 ounces of dragon's blood. These in fine powder are dissolved on the water bath, in 500 ounces rectified spirit. The spirit must boil and remain, with occasional shaking, for 2 to 3 hours on the bath. Then cool and decant. In the meantime heat in another flask on the bath 30 ounces of gamboge in 500 ounces of the same spirit. The two liquids are mixed until the right color needed for the particular purpose in hand is obtained. Dilute with spirit if too thick. The addition of a little picric acid gives a greenish-yellow bronze but makes the varnish very liable to explode. . These varnishes are applied to gently warmed surfaces with a soft bristle brush.

Gold Varnish for Tin.—This is obtained in the following manner: Spread out 5 parts, by weight, of finely powdered crystallized copper acetate in a warm spot, allowing it to lie for some time; then grind the powder, which will have acquired a light-brown shade, with oil of turpentine and add, with stirring, 15 parts, by weight, of fat copal varnish heated to 140° F. When the copper acetate has dissolved (in about ¼ hour), the mass is filled in a bottle and allowed to stand warm, for several days, shaking frequently. The gold varnish is then ready for use. Coat the articles uniformly with it, and heat in a drying chamber, whereupon, according to the degree of temperature, varying colorations are obtained, changing from green to yellow, then golden yellow, and finally orange to brown. When good copal varnish is employed, the varnish will adhere very firmly, so that the article can be pressed without damage.

MODERN VARNISH MAKING.

Like most commodities there is a great difference in the composition of present day varnishes as compared with those of several years back. While linseed oil is still used in making various types of varnishes it has been superseded mostly by the now well known China Wood Oil or often known as Tung Oil. It could be stated without exaggeration that at least 80% of the varnish made consists mostly of China Wood Oil as the type of oil used.

Likewise a great change has taken place in the solid materials used for during the past the gums and resins used chiefly were those natural gums such as Copals, Manillas, Damars, Elemis, etc., while the cheaper varnishes today use as the base Rosin Ester, a resin produced by nature but chemically treated so that it is called an artificial resin. Most cheap varnishes and a few medium grade are made with the use of this gum as the solid material and in a few instances other natural gums are incorporated with this gum to produce varnishes giving various results.

The greatest improvement perhaps is found in the varnishes that are made, using a synthetic resin of the Amberol type as the solid content. Amberol is today too well known as a leading synthetic resin to make it necessary to describe it. We might state that this resin will enable a varnish maker to produce a varnish with all around qualities such as hardness, waterproofness, durability, etc., something that has never quite been accomplished with the use of natural gums. In addition it has been found that certain varnishes, properly made with the use of Amberol will produce a film that will dry dust free in less than two hours and hard in less than five hours. These varnishes are well named "Four Hour Varnishes" and are exceedingly popular today.

Since there are an endless number of varnish formulas for every conceivable purpose it would be impossible to occupy space with a complete list of them but it will suffice to give the formulas for those most commonly required and out of these various kinds can be experimented with and produced. It might be well to also state that making varnish has always been considered as requiring great skill. Science and Chemistry has accounted for many of the seeming

phenomena in the past, yet even trained varnish Chemists will still acknowledge that the varnish making is somewhat of an art even though careful scientific principles laid down are followed. The manipulation of the cooking of the resins, heating of oils, etc., still remains something of an art and therefore experience and continual experimentation is of unestimated value.

There is always danger of a fire since the fumes are highly inflammable and it is always customary for the varnish maker to have several heavy burlap sacks which are wet, handy so he can put them over the flame and smother a fire. Carbon Tetachloride in hermetically sealed bulbs is now obtainable from dealers and these can be thrown at the fire also. Do not try to put out a varnish fire with a soda and acid extinguisher or with water for they will both spread the flames.

NOTES ON VARNISH MAKING.

Batches of varnish are usually prepared taking one hundred pounds of gum or resin as the solid material and from twenty to fifty gallons of oil as the cooking medium. In other words it is hardly profitable or worth while to go to the expense and bother of cooking varnish in less quantities than this.

Copper kettles are usually used and will last for a long time if properly used.

It is the custom among the large varnish makers to make up three or four standard varnishes out of the natural gums such as Manilla, Kauri, Damars, etc., and by intermixing these various types can produce almost an endless variety of finishing varnishes. For instance it is known that the varnishes made from the use of Kauri Gum will produce tough films and out of these are made our Spar Varnishes. Manilla gums produce softer and more brittle varnishes and by a system of mixing certain proportions together a varnish of almost any strength or durability can be obtained.

A Varnish firm advertising a dozen or more different grades of varnish may only make two or three grades but label them differently and as a rule the public and even professional painters and decorators cannot tell the difference.

However, most of the reliable concerns mix up various batches to get the type of material they desire.

One must not, however, mix the varnishes made from the natural gums with those made from synthetic resins such as Amberol and others for he will find that they will not mix together properly and if he tries it he will get into trouble.

Varnish cooking is an art. The formulas given in this book will not make it entirely possible for one to properly cook a batch of varnish for the experienced and expert varnish maker knows exactly how hot to have his fire, how long to cook the varnish, how rapidly he must reach the top heats, etc., and it is these important things that will make or break the varnish. To the beginner we suggest he make up very small batches at first and carefully time his cooking, taking temperatures with a thermometer very often and keep close watch of everything he does so that he can repeat the job if the varnish proves to be a good one. This must be emphasized so that the inexperienced one will not be disappointed at his results.

There are of course many formulas for making many kinds of varnishes. Oftentimes, however, the same formula is used in producing a varnish that is sold under a variety of names and for a variety of purposes. Some varnish manufacturers who may not be over scrupulous will make a varnish using 150 pounds of Rosin Ester Gum to 400 pounds of China Wood Oil, cook it, add the thinners and driers and label it as Floor Varnish, Interior Varnish, Spar Varnish and what not. And of course the buying public seldom knows the difference. It is needless to say that there is a great difference.

Floor Varnishes Using Synthetic Resin (Amberol, Bakelite or Durez).—

Amberol F-7	45	lbs.
China Wood Oil	10	gallons
Heavy Bodied Linseed Oil	1½	gallons
Lead Resinate	5	lbs.
Liquid Cobalt Resinate	1	pint
Liquid Manganese Resinate	½	pint
Thinners	22	gallons

The Amberol and China Wood Oil are heated together in a varnish kettle to 540 degrees F. The heat is held there for a few minutes. A drop of this melted material should be put on a glass and when it strings to about 7 inches before breaking (must string to a fine thread) add the Lead Resinate and Linseed Oil. Then cool the mixture to 450 degrees F. and reduce with the Thinners, which should consist of Mineral Spirits. Then add the driers. This varnish should dry dust free in about one hour and one half, while it ought to be hard in five hours, if properly prepared.

Interior Varnish.—

Amberol B S 1	45	lbs.
China Wood Oil	11	gallons
Heavy Bodied Linseed Oil	1	gallon
Lead Resinate	2¼	lbs.
Liquid Cobalt Drier	1	pint
Liquid Manganese Drier	½	pint
Thinners	18	gallons

Prepare in much the same way as Floor Varnish, only add heat Wood Oil up with ½ of the amount of Amberol called for in formula, up to temperature or 565° F. Hold for a string as described above. Then add the Linseed Oil, remainder of Amberol and Lead Resinate. Hold at 450 degrees F. for a few minutes until all of the remaining Amberol is taken up. Then drop temperature few degrees and add Thinners. This varnish has about the same drying qualities as the Floor Varnish.

Old Fashioned Hard Gum Kauri Varnish.—

100 pounds Kauri Gum
15 gallons Linseed Oil
5 gallons Turpentine
15 gallons substitute turpentine
1 quart liquid drier

Melt resin thoroughly in linseed oil. Temperature will run around 500 degrees F. although a certain temperature is not the desirable point. With the stirring rod one can feel when the resin is all melted. This usually requires from ¾ of an hour to 1½ hours depending upon the kind of oil, quality and amount of both oil and gums. After the resin has been cooked and is melted thoroughly in the oil it is cooled down to admit the reduction with turpentine and thinner, also to add the drier.

Spar Varnish.—No doubt but the most common and best spar varnishes are today made from the synthetic resins such as Amberol which is used in other formulas. The following formula will give an idea to work from, the combination being a tried and proven spar varnish:

Amberol F-7	50 pounds
China Wood Oil	18 gallons
Heavy Bodied Linseed Oil	4 gallons
Lead Resinate	6 pounds
Turpentine	5 gallons
Varnolene	35 gallons
Liquid Cobalt Drier	3 pints
Liquid Manganese Drier	2 pints

The Wood Oil and Amberol is heated to 565 degrees F. and it is held there for string on glass to nine or ten inches. The Lead Resinate and Linseed Oil are then added. The mixture is then cooled to about 450 degrees F. when the thinners and driers are added.

Experimentation with different kinds of resins and gums mixed with different proportions of linseed and china wood oil must be made to determine the results desired as only practice will enable one to produce the material required. Let it be remembered that Varnish Cooking is an art, not simply a mixing and heating process. It is important to know that varnishes made with natural gums as the solid content and cooked with different proportions of oils and thinners can be mixed together after they are made, to obtain different kinds of finished varnishes. As an example: Oftentimes a copal varnish will be mixed together with a Kauri Varnish to produce a varnish having certain working qualities which a painter or manufacturer desires. For this reason many manufacturers make only three or four varnishes in the kettles and by intermixing these obtain various kinds of products, suitable for a variety of purposes.

Architectural Oil and Varnish Stains.—It is very simple to make up a varnish stain or an oil stain. In the case of a varnish stain a given proportion of strong tinting color ground in oil is added to a gallon of varnish and additional dryer is also added. In making oil stains merely add a certain amount of color ground in oil to a gallon of linseed oil, also a given amount of dryer and V. M. & P. Naptha.

Varnish Stains.—Walnut Varnish Stain. Add 12 ounces of Burnt Umber, ground in oil to each gallon of quick drying varnish. If it dries too slow add a little turpentine or V. M. & P. Naptha.

Oak Varnish Stain. Add 15 ounces of ochre in oil to each gallon of quick drying varnish.

Mahogany Varnish Stain. Add 5 ounces of Venetian Red in Oil, also 7 ounces Burnt Sienna in Oil, to gallon varnish.

Green Varnish Stain. Add 15 ounces Chrome Green to one gallon quick drying varnish.

Cherry Varnish Stain. Add 6 ounces French Ochre and 8 ounces Burnt

Sienna to one gallon quick drying varnish.

The above suggestions will enable the beginner to make up almost any color after experimentation.

Oil Stains are made in somewhat the same manner except that it is advisable to add about ½ pint of good liquid dryer to each gallon of varnish. It may also be necessary to thin somewhat with V. M. & P. Naptha.

Shellac Varnishes.—There are various grades of Pure Shellac and during the last few years no product has been more misrepresented than Pure Shellac. The Government now refuses to allow any dealer to adulterate Pure White Shellac and still label it "Pure Shellac" and a penalty is carried with this ruling so that today, one purchasing Pure Shellac on the open market and labeled thus, is almost certain to get the genuine article.

Pure Shellac can be obtained in either White or Orange and ranges in a variety of cuts from 3 pounds to a gallon of alcohol to 5 pounds in a gallon. Factories usually purchase it four pounds to a gallon and perhaps most cutters use this amount as standard. For many purposes in architectural work or for finishing hard wood floors, Pure Shellac has never been equalled.

There are many products on the market sold as "Shellac Substitutes" and some have quite a wide sale for cheap work, where the cost of using Pure Shellac is not allowed but no substitute has yet ever measured up to the quality and working conditions of the genuine article. Loud claims are made for various products some being copals in solution, Ester Gums and various synthetic resins and are often offered at around one half the price of the Pure Shellac. For an undercoat under a varnish surface it knows no equal and is still widely used in this respect.

Varnish for Playing Cards.—

56 pounds gum elemi
4 gallons methylated spirit

Varnish (Bright) for Ship's Use.—

Pale rosin	168 pounds
Rosin oil	252 pounds
Rosin spirit	42 pounds

Sweat rosin at 300° F. for four hours; add oil and continue boiling for one hour. Take from the fire and cool down to 200° F. and carefully add the spirit, well stirring in. Rectified or crude rosin spirit, according to price.

VASELINE STAINS, TO REMOVE FROM CLOTHING:
See Cleaning Preparations and Methods.

VASOLIMENTUM.

This unguent is of two kinds, liquid and semi-solid. The former is prepared by mixing 500 parts of olein, 250 parts of alcoholic ammonia, and 1,000 parts of liquid paraffine, the whole being warmed until completely dissolved, and any loss in weight made up by addition of spirit. The semi-solid preparation is made of the same ingredients, except the paraffine salve is substituted for the liquid. The product is used as a basis for ointments in place of vasogene, and can be incorporated with a number of medicaments, such as 10 per cent of naphthol, 20 per cent of guaiacol, 25 per cent of juniper tar, 5 per cent of thiol, 6 per cent of iodine, 5 per cent of creosote, 10 per cent of ichthyol, 5 per cent of creolin, 2 per cent of menthol, etc.

VAT ENAMELS AND VARNISHES:
See Varnishes.

VEGETABLES, TESTS FOR CANNED:
See Foods.

VEGETABLE PARCHMENT:
See Parchment.

VICHY:
See Waters.

VICHY SALT:
See Salts (Effervescent).

Veterinary Formulas

FOR BIRDS:

Asthma in Canaries.—

Tincture capsicum...	5 drachms
Spirits chloroform...	90 minims
Iron citrate, soluble..	45 grains
Fennel water........	3½ ounces

Give a few drops on lump of sugar in the cage once daily.

Colas.—

Tincture ferri perchloride.....	1 drachm
Acid hydrochloric, dil.	½ drachm
Glycerine..........	1½ drachms
Aqua camphor, q. s..	1 ounce

Use 3 to 6 drops in drinking water.

Ointment for Healing.—

Peru balsam	60 grains
Cola cream.........	1 ounce

Apply.